भारतीय मानक
Indian Standard

IS 17264 : 2022

वस्त्रादि — पालिएस्टर औद्योगिक धागे — विशिष्टि

(पहला पुनरीक्षण)

Textiles — Polyester Industrial Yarns — Specification

(First Revision)

ICS 59.080.20

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Man-made Fibres, Cotton and their Products Sectional Committee, TXD 31

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Man-made Fibres, Cotton and their Products Sectional Committee had been approved by the Textiles Division Council.

Polyester is a highly durable polymer. It has an improved wrinkle resistance, a high tenacity and a high colour retention. Moreover, polyester polymer is less vulnerable to shrinkage in comparison to other polymers, it is very resistant to abrasion and is not affected by moisture. Polyester high tenacity yarn for industrial applications stands out with high tensile strength and good ultraviolet light (UV) stability.

This standard was first published in 2019 and has been revised to incorporate the following major changes:

a) Requirement and test method for identification of material has been incorporated;
b) All amendments have been incorporated;
c) Table for examples of notation of textile yarns has been modified;
d) Special characteristics of polyester industrial yarn (IDY) has been modified;
e) Table for physical and chemical requirements of polyester industrial yarn has been modified;
f) Freedom from yarn defects has been modified;
g) Method of test for hot air shrinkage has been modified;
h) Marking and packing clause has been modified; and
j) References to Indian Standards have been updated.

The composition of the Committee responsible for the formulation of this standard is given in Annex G.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

TEXTILES — POLYESTER INDUSTRIAL YARNS — SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies requirements for all types of virgin and recycled polyester industrial yarns (IDY) for various end usages.

2 REFERENCES

The standards listed in Annex A contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMS AND DEFINITIONS

For the purpose of this standard, the following definitions in addition to those specified in IS 1324 shall apply.

3.1 Creep — Creep is the tendency of a solid material to move slowly or deform permanently under the influence of mechanical stresses. It can occur as a result of long-term exposure to high levels of stress that are still below the yield strength of the material.

3.2 Creep Resistant Yarn — A yarn which is resistant to creep when subjected to repeated mechanical stresses for prolonged exposure.

3.3 Commercial Allowance — A defined percentage to be added to the oven-dry mass of the material for the calculation of commercial mass and certain other properties. This allowance includes the moisture content and the content of the substances which can be removed during analysis, for example, spin finish, oligomers etc.

NOTE — The commercial allowance for polyester IDY shall be 2.0 percent.

3.4 Commercial Mass — The mass obtained by adding to the oven-dry mass, the mass corresponding to the commercial allowance.

3.5 Flat Yarn — Man-made continuous filaments that have not been twisted or textured.

3.6 High Tenacity Yarn — A yarn with a significantly higher breaking tenacity than others of the same generic category, generally used because of that main characteristic.

NOTE — At Present, the minimum limit used for high tenacity polyester industrial yarns is 7.2 gpd (grams per denier) (63.5 cN/tex).

3.7 Shrinkage — The decrease in length of a test specimen caused by a specified treatment, expressed as a percentage of the length of the untreated test specimen. The lengths are measured before and during or after treatment under specified tensions.

3.7.1 *Hot Air Shrinkage* — The decrease in length of a test specimen caused by a treatment in hot air under specified conditions of temperature and time, expressed as a percentage of the length of the untreated test specimen. The lengths are measured before and after treatment under a specified pretension.

3.8 Industrial Filament Yarn — Yarn intended for industrial applications and use in products principally but not exclusively for their performance and properties as opposed to their aesthetic or decorative characteristics.

3.9 Oven-dry Mass — The mass obtained by drying the filament yarn usually after removal of added products such as finish, oil and extractable matters.

3.10 Super High Tenacity Yarn — A yarn with a significantly higher breaking tenacity than others of the same generic category generally used because of that main characteristic.

NOTE — At present, the minimum limit used for super high tenacity polyester industrial yarns is 8.4 gpd (grams per denier) (74 cN/tex).

4 TYPES

The following types of industrial yarns are covered in this standard which may be used in different suitable combinations.

4.1 High Tenacity (HT) and Super High Tenacity (SHT) Yarn

High tenacity (HT) yarns are required in a variety of industrial applications, such as conveyor belts, ropes, geo-grids, lashings / slings, automotive seat belt, industrial fabrics. Product denier range is from 30 denier to 6 000 denier. Super high tenacity (SHT) yarns with tenacity > 8.4 gpd have high strength, low elongation, superior creep performance, exceptional durability, high strength-to-weight ratios, abrasion resistance, etc.

4.2 Adhesive Activated Yarn

Adhesive activated yarns are used for rubber coating application, such as conveyor belts and transmission belts. They are equivalent to super high tenacity yarns. These have excellent rubber adhesion for mechanized rubber goods.

4.3 Low Shrinkage (LS)/Super Low Shrinkage (SLS) Yarn

Low shrinkage yarn helps to maximize fabric width, yield and flatness. Consistent and regular values make it reliable for wide fabrics manufacturers and coaters. Hence, coated and laminated fabrics forms the major application for LS/SLS products. Some of the applications identified for LS/SLS application are include tarpaulins, sewing threads, bill boards, awnings, roofing, architectural structures, tents, canvas, banners, industrial tubing, etc.

4.4 Low Denier Industrial Yarn

Low denier industrial yarn covers denier range 300-500 denier and are used for mosquito nets, fishing nets, sewing or stitching applications etc.

4.5 High Modulus Low Shrinkage (HMLS) Yarn

Tyre cord are the main application of HMLS yarn along with large application in dipped cords for transmission belts (conveyor and V-belts).

4.6 Super High Tenacity – Low Elongation (SHT-LE) Yarn

SHT-LE type of IDY are mainly used in manufacturing geotextiles and geo-grids.

4.7 Coloured Industrial Yarn

Dope dyed industrial yarns find their use in making coloured slings, webbings, ropes and nettings.

4.8 Flame Retardant Yarn

Flame retardant yarn shrinks on flaming and do not catch or spread flame. Flame retardant yarn are used for applications where flame retardancy is required, for example, curtain, drape, furnishing, outer protective clothing, uniform, tents and tarpaulins etc.

4.9 Ultraviolet Light Resistant Yarn

Ultraviolet resistance yarn has high resistance to UV light exposure for prolonged periods. These are mainly used in geotextiles, geogrids, awnings, architectural fabrics, sun protective clothing etc.

5 DESIGNATION AND DESCRIPTION OF INDUSTRIAL FILAMENT YARN

5.1 Designation of Yarn

A recommended standard notation for yarn designation as per the industry practices based on yarn construction is specified in Table 1. The notation reflects in a condensed form the details of components of a yarn, including values of the linear densities, direction of twist, twist level, number of folds, etc. of these components and/or characteristics, such as linear density resulting from this construction. Two methods for the notation of yarns have been specified. The ‘single to fold’ notation starts from the linear density of the single yarn; the ‘fold to single’ notation starts from the linear density of the resultant yarn. The symbols used in both systems are identical; the differences are in the order of presentation, the use of the multiplication sign (x) in the single to fold notation, and of the solidus (/) in the fold to single notation. Distinction between the two methods does not apply to monofilament and multifilament yarns without twist, nor to multiple wound yarns. The following symbols are used:

R = symbol for resultant linear density, to be put before its numerical value;

F = symbol for filaments, to be put before the number of filaments; and

t_0 = symbol for zero twist; other twist values are represented by the number of turns per metre of the twisted yarn, preceded by S or Z to indicate twist direction.

If the S/Z notation cannot be used, for example in numerical fields of data banks, ‘S’ should be designated as (−) and ‘Z’ as (+). The notation is best illustrated by examples given in Table 1.

5.2 Identification and Description

5.2.1 The material of the yarn, that is polyester, shall be identified by confirmatory tests either as per:

a) Microscopic and dissolution test given in IS 667 and melting point of 245°C, *Min* when tested as per method specified in Annex J of IS 16481; or

b) Staining tests given in IS 667.

5.2.2 The polyester industrial yarn shall be described using the classification (*see* **4**), the designation of the yarn (*see* **5.1**) and identification of polyester industrial yarn as given in Table 2.

Table 1 Examples of Notations of Industrial Yarns

(*Clause* 5.1)

Sl No.	Type of Yarn	'Single to Fold' Notation	'Fold to Single' Notation
(1)	(2)	(3)	(4)
i)	**Single yarns**		
	Single yarn without twist	1100 dtex f192; R1100 dtex	R1100 dtex; 1100 dtex f192
	Single yarn with twist	1100 dtex f192	R1100 dtex 60; 1100 dtex S60
ii)	**Multiple wound yarns with**		
	Similar components	1100 dtex S60 × 2	-
	Dissimilar components	(1100 dtex S60 + 920 dtex Z80)	-
iii)	**Doubled, folded or plied yarns with**		
	Similar components	1100 dtex S60 x 2Z60; R2220 dtex	R2220 dtex S60 / (S60 + Z60)
	Dissimilar components	(1100 dtex S60 + 920 dtex Z80)	(1100 dtex + 920 dtex); R2220 dtex
iv)	**Cabled yarns with**		
	Similar components	20 tex Z700 × 2 S400 × 3 Z200; R132 tex	R132 tex; Z 200 / 3 S400 / 2 Z700; 20 tex
	Dissimilar components	(20 tex Z700 × 3 S400 + 34 tex S600) Z200	R96 tex Z200 (S600 + S400 / 3Z700); 34 tex

NOTES:

1 Prefixes and multiples shall be written without space.

2 A space shall be used to separate the different characteristics of the yarn construction.

3 × or / used to mark multiple yarn components shall be separated with spaces.

4 Addition of the resultant linear density in the 'single to fold' notation, and of the single yarn linear density in the 'fold to single' notation, is not obligatory; such information is separated from the preceding notation by a semi-colon. If not needed, the direction of twist and the twist level may be omitted; however, the description of twist less yarns may include the symbol for zero twist.

5 Values of linear density and of twist level used in commercial transactions are usually nominal values and are subject to tolerances as per this standard.

Table 2 Identification of Polyester Industrial Yarn

(*Clause* 5.2.2)

Sl No.	Special Characteristics	Examples
(1)	(2)	(3)
i)	Multifilament	250/48, 500/96, 1000/192
ii)	Fibre cross-section	Round
iii)	Filament count	500/96 Filament count is 96
iv)	Denier per filament	1 000/192 DPF = 5.20
v)	Overall denier	840/192 (840)
vi)	Twist or twist substitute	1.5 TPI Air Entanglement
vii)	Single or plied	1/70/48, 2/220/110
viii)	Flame retardant	FR
ix)	Heat resistant	HR
x)	Ultra violet light resistant	UV
xi)	Low shrinkage	LS
xii)	Super low shrinkage	SLS
xiii)	Low elongation	LE
xiv)	Adhesive activated	AA
xv)	High modulus low shrinkage	HMLS
xvi)	High modulus low shrinkage Adhesive Activated	HMLS AA
xvii)	Super high tenacity	SHT
xviii)	Super high tenacity adhesive activated	SHT AA

NOTES:

1 Special characteristics other than above may also be included in the yarns as agreed to between the buyer and seller, provided the finished product meets the requirements of this standard.

2 The description of various special characteristics given in Table 2 is for information and use only to indicate the identification of industrial yarn.

6 REQUIREMENTS

6.1 The linear density, tenacity, elongation and hot air shrinkage of polyester industrial yarn (IDY) shall be declared by the manufacturer within the specified range and shall fall within the tolerances specified in Table 3 in accordance with the description of the yarn.

6.2 The polyester industrial yarn (IDY) shall meet the chemical requirements specified in Table 4.

6.3 Freedom from Yarn Defects

The yarn packages shall be free from the following defects (*see also* **9.3.2**).

6.3.1 *Insufficient Air Tacks (Entanglements)* — Minimum 3 tacks for ≤ 2 000 denier and minimum 1 tacks per meter for > 2000 denier for regular air shall be allowed.

6.3.2 *Broken Filaments* — Broken filaments/loops in a package shall not be more than that given below:

Package Size, kg	Permissible Broken Ends	
	Broken Filaments	Loops
< 5	2	3
5 to 10	3	7
>10 to 15	5	9

6.3.3 *Crossed Ends* — Nose end crosses can be allowed, unless they appear matted or too numerous to count. Up to two 25 mm crosses on the tail end shall be allowed and crosses < 6 mm from the tube can be allowed.

6.3.4 *Damaged/Bumped* — No filaments cuts or loops shall be allowed. Only touching impression of up to 5 mm depth may be allowed.

6.3.5 *Dirt/Grease* — No soiling or grease spots shall be allowed. It is acceptable if the spots can be cleaned off. Defect with slight grey/yellow stains shall not be more than 0.5 per kg and more than 5 mm in length.

6.3.6 *Finish Oil Contamination* — Dry or regular oil yarn shall not be contaminated with finish oil when viewed under a packing table UV light, unless very slight (not immediately visible). Strip to clean if possible. Otherwise, reject to off-grade.

6.3.7 *Improper Ply* — Count the number of ends if the yarn is three ply or more. Also check the number of tails. Improper ply having different number of ends and tails shall not be allowed.

6.3.8 *Improper Wind* — No patterns or bands, no high or falling off edges and no excessive hard/soft packages shall be allowed.

6.3.9 *Inadequate Tube Clearance* — It shall be 9 mm, *Min* from yarn roll to tail end of tube and 25 mm *Max* (nominal should be 15 mm).

6.3.10 *Indistinct Tail* — Tail end coils to be distinct and minimum tail length shall be one wrap around the tube. Missing, bunch and multiple tails need not to be off graded. Permissible limit for packages without tail shall be less than 6 percent.

6.3.11 *Loops* — Not more than 1.5 loops per kg of yarn each of length less than 10 mm shall be allowed.

6.3.12 *Oversize or Small Packages* — Check suspect packages with appropriate gauge, scale, diameter tape or balance. All equal length bobbins of respective products should be graded and packed separately. Unequal length bobbins are to be graded based on their weights and packed in respective grades. Bobbins with different sizes in terms of length and weight, packed in same package shall not be allowed.

6.3.13 *Ridges/Grooves* — Ridges or grooves > 5 mm high or deep shall not be allowed.

6.3.14 *Slubs/Kinks* — None shall be allowed.

6.3.15 *Tube Defects* — Crushed, nicked, or cut tubes, especially on the nose end. None shall be allowed.

6.3.16 *Uneven Fluorescent Oil* — If applicable, the package(s) having uneven coverage under UV light shall not be allowed.

6.3.17 *Wound in Waste* — May be accepted if it can be corrected by stripping.

6.4 Colour Fastness Properties

The dope dyed yarns shall meet the respective colour fastness requirements as specified in Table 5.

Table 3 (Physical Requirements of Polyester Industrial Yarn

(*Clauses* 6.1 *and* 8.2)

Sl No.	Type	Linear Density, Denier (dtex)		Tenacity, gpd (cN/dtex)		Elongation, Percent		Hot Air Shrinkage, Percent	
		Range	Tolerance, Percent	Range	Tolerance	Range	Tolerance	Range	Tolerance
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	LS	Up to 500 (Up to 556)	± 2.5	7.0 – 8.0 (6.2 – 7.1)	± 0.4 (0.4)	16.0 – 22.0	± 3.0	3.0 – 4.0	± 1.0
ii)	LS	> 500 – 2000 (> 556 – 2222)	± 2.5	7.0 – 8.5 (6.2 – 7.2)	± 0.4 (0.4)	17.0 – 23.0	± 3.0	3.0 – 4.5	± 1.0
iii)	SLS	500 –2000 (556 – 2222)	± 2.5	6.5 – 7.5 (5.7 – 6.6)	± 0.4 (0.4)	19.0 – 23.0	± 3.0	2.0 – 3.0	± 1.0
iv)	HT	30 – 500 (33 – 556)	± 2.5	7.5 – 9.0 (6.6 – 7.9)	± 0.4 (0.4)	12.0 – 16.0	± 2.0	5.0 – 7.0	± 2.0
v)	HT	> 500 – 3000 (> 556 – 3333)	± 2.5	8.2 – 9.2 (7.2 – 8.1)	± 0.4 (0.4)	12.0 – 16.0	± 2.0	5.0 – 7.0	± 2.0
vi)	SHT	500 – 3000 (556 – 3333)	± 2.5	8.6 – 9.6 (7.6 – 8.5)	± 0.4 (0.4)	11.0 – 15.0	± 2.0	6.5 – 8.5	± 2.0
vii)	SHT	> 3000 – 6000 (> 3333 – 6667)	± 2.5	8.4 – 9.4 (7.4 – 8.3)	± 0.4 (0.4)	11.0 – 15.0	± 2.0	6.5 – 8.0	± 2.0
viii)	LE	1000 – 3000 (1111 – 3333)	± 2.5	9.0 – 9.7 (7.9 – 8.6)	± 0.4 (0.4)	9.5 – 11.5	± 2.0	10.0 – 12.0	± 2.0
ix)	LE	> 3000 – 6000 (> 3333 – 6667)	± 2.5	8.8 – 9.4 (7.8 – 8.3)	± 0.4 (0.4)	9.5 – 11.5	± 2.0	10.0 – 12.0	± 2.0
x)	SHT-AA	500 – 3000 (556 – 3333)	± 2.5	8.6 – 9.6 (7.6 – 8.5)	± 0.4 (0.4)	11.0 – 15.0	± 2.0	6.0 – 8.0	± 2.0
xi)	HMLS	1000 – 3000 (1111 – 3333)	± 2.5	7.6 – 8.2 (6.7 – 7.2)	± 0.4 (0.4)	11.0 – 13.0	± 2.0	3.0 – 4.0	± 1.0
xii)	HMLS-AA	1000 – 3000 (1111 – 3333)	± 2.5	7.6 – 8.4 (6.7 – 7.4)	± 0.4 (0.4)	11.0 – 13.0	± 2.0	3.2 – 4.2	± 1.0
xiii)	DD	30 – 3000 (33 – 3333)	± 2.5	7.2 – 9.2 (6.4 – 8.1)	± 0.4 (0.4)	12.0 – 16.0	± 2.0	5.0 – 7.0	± 2.0
	Method of Test	IS 7703 (Part 1)	-	IS 7703 (Part 2) (*see* NOTE)	-	IS 7703 (Part 2)	-	Annex F	-

NOTES:

1 IDY being high tenacity and low elongation, the time for yarn break can be as low as 6 s instead of 20 s as specified in the test method.

2 Elongation at specified load (4.5 grams per denier) shall be (5.0-6.0) ± 0.5 percent for HMLS and HMLS-AA

Table 4 Chemical Requirements of Polyester Industrial Yarn

(*Clauses* 6.2)

Sl No. (1)	Characteristic (2)	Requirement (3)	Method of Test (4)
i)	Moisture regain, percent, *Max* at equilibrium condition	0.4	Annex B
ii)	Isophthalic acid (IPA) content, Percent, *Max*		Annex C of IS 16481
	a) Virgin polyester yarn	Not detected	
	b) Dope dyed/white yarn	0.1	
	c) Recycled polyester yarn	2.2	
iii)	Water soluble matter, percent, *Max*	1.6	IS 3456
iv)	Finish oil pick-up (as declared), percent with a tolerance of ± 30 percent	(0.5-1.1)	Annex C
v)	Phosphorus content, percent, *Min* (For fire retardant yarn only)	0.65	Annex D
vi)	Ultraviolet resistance, 500 h Percent retained strength, *Min* (For UV resistant yarn only)	70	IS 13162 (Part 2)
vii)	Colour strength with reference to standard yarn, percent (For dope dyed yarns only) (*see* NOTE)	100 ± 4	Annex E
viii)	Colour difference with reference to standard yarn, measured as ΔE, *Max* (for dope dyed yarns only) (*see* NOTE)	1.5	Annex E

NOTE — Either of the requirements indicated at vii) and viii) needs to be complied with.

Table 5 Colour Fastness Properties

(*Clause* 6.4)

Sl No. (1)	Colour Fastness Rating To (2)	Requirement, *Min* Dope Dyed (3)	Method of Test (4)
i)	Light		IS/ISO 105-B01 or
	Change in colour	5-6 or better	IS/ISO 105-B02
ii)	Rubbing		IS/ISO 105-X12
	a) Dry	4-5 or better	
	b) Wet	3-4 or better	

6.5 Commercial Mass

The commercial mass shall be obtained by adding mass corresponding to commercial allowance of 2.0 percent to the oven dry mass of the consignment when tested by the methods prescribed in IS 7703 (Part 3) and it shall not be less than the declared commercial mass of the consignment.

6.6 Additional Requirements for Ecomark (Optional)

For Ecomark, the product shall also comply with the additional requirements as given in Table 6.

7 PACKING

7.1 The polyester industrial yarn (IDY) shall be wound over bobbins or cheeses in any mass up to 14 kg of yarn per bobbin/cheese. All such packages shall be to be packed in pallets or cartons, properly strapped using polypropylene/PET straps. Packing materials should be roadworthy/airworthy/sea worthy as agreed to between the buyer and the seller.

7.2 All wooden pallets are to be heat treated. All wooden/paper packing should be free from infestation/ fungal growth.

NOTE — Container fumigation for domestic supply should be optional.'

8 MARKING

8.1 Each carton/pallet of polyester industrial yarn (IDY) shall be marked with indelible ink, the following information:

a) Name and description of the material (*see* **5.2**);
b) Designation of the material (*see* **5.1**);
c) Commercial mass of each carton/pallet;
d) Manufacturer's name, address and trade-mark (if available);
e) Lot/batch/merge number;
f) Month and year of manufacture; and
g) Any other information required by the law in force.

Table 6 Additional Requirements for ECO-Mark (Optional)

(*Clause* 6.6)

Sl No. (1)	Characteristic (2)	Requirement (3)	Method of Test (4)
i)	Free and releasable formaldehyde, mg/kg (ppm), *Max*	20	IS 14563 (Part 1) and IS 14563 (Part 2)
ii)	Extractable heavy metals by artificial acidic sweat/saliva, ppm, *Max*		Annex A of IS 15651
	a) Mercury	0.1	
	b) Chromium III	0.1	
	c) Chromium VI	Not detected	
	d) Lead	0.2	
	e) Cadmium	0.1	
	f) Copper	25	
	g) Antimony	30	
iii)	Pentachlorophenol, ppm, *Max*	0.5	Annex B of IS 15651
iv)	Pesticides (sum parameter), ppm, *Max*	1.0	Annex D of IS 15651
v)	Banned pesticides, ppm, *Max*	Not detected	Annex D of IS 15651
vi)	Banned azo colourants (arylamines), mg/kg (ppm), *Max.* (for dyed yarn only) (sum parameters)	20	IS 15570

8.1 1 *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

8.2 The declared parameters as per Table 3 shall be provided in the form of a technical data sheet by either pasting on the package or provided separately linking it with lot/batch/merge no. on request for domestic supplies.

8.3 Instructions for transportation and handling of the material shall also be provided by the manufacturer for proper care of the product.

9 SAMPLING AND CRITERIA FOR CONFORMITY

9.1 Lot

The number of packages (*see* **7.1**) in all cartons/pellets of polyester industrial yarn (IDY) of the same description and designation delivered to a buyer against one dispatch note shall constitute a lot.

9.2 The number of packages to be selected at random from a lot shall be according to column 3 of Table 7. The packages shall be selected at random from different cartons/pallets to constitute the sample size. To ensure the randomness of selection, IS 4905 may be followed.

9.3 Number of Tests and Criteria for Conformity

9.3.1 The number of packages to be selected for manufacturing defects shall be in accordance with column 3 of Table 7. For all other properties, the number of packages selected shall be in accordance with column 5 of Table 7. These packages may be selected from the packages selected for non-destructive tests.

9.3.2 All the packages selected from the lot shall be visually examined for yarn defects as specified in **6.3.** Four such defects will be considered as one major defect. A package shall be considered defective if it contains any major defect. All the packages selected for destructive tests shall be tested for the requirements as specified in **6.1**, **6.2** and **6.4** to **6.6** as applicable.

9.3.3 The lot shall be declared conforming to the requirements of this standard if the total number of defective packages does not exceed the value given in column 4 of Table 7 for yarn defects or column 6 of Table 7 for other requirements.

Table 7 Number of Packages of Yarn to be Selected

(*Clauses* 9.2, 9.3.1 *and* 9.3.3)

Sl No.	**Lot Size**	**Non-Destructive Testing**		**Destructive Testing**	
		No. of Packages to be Selected	Acceptance Number	No. of Packages to be Selected	Acceptance Number
(1)	(2)	(3)	(4)	(5)	(6)
i)	Up to 280	13[1]	1	8	0
ii)	281 – 500	20	2	8	0
iii)	501 – 1 200	32	3	13	0
iv)	1 201 – 3 200	50	5	13	0
v)	3 201 – 10 000	80	7	20	1

[1] or lot size when less than 13.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
667 : 1981	Methods for identification of textile fibres (with supplement) (*first revision*)
3456 : 1966	Method for determination of water soluble matter of textile materials
4905 : 2015	Random sampling and randomization procedures (*first revision*)
6359 : 1971	Method for conditioning of textiles
7703	Methods of test for continuous filament polyester and polyamide flat yarn
(Part 1) : 1990	Linear density (*first revision*)
(Part 2) : 1990	Dry and wet tenacity and elongation (*first revision*)
(Part 3) : 1991	Commercial mass (*first revision*)
13162 (Part 2) : 1991	Geotextiles — Methods of test: Part 2 Determination of resistance to exposure of ultra-violet light and water (Xenon arc type apparatus)
14563	Textiles — Determination of formaldehyde
(Part 1) : 2021	Free and hydrolysed formaldehyde water extraction method (*first revision*)
(Part 2) : 2021	Released formaldehyde vapour absorption method (*first revision*)
15570 : 2005	Textiles — Method of test — Detection of banned azo colourants in coloured textiles
15651 : 2006	Textiles — Requirements for environmental labelling — Specification
16481 : 2016	Textiles — Synthetic micro-fibres for use in cement based matrix — Specification
IS/ISO 105-B01 : 2014	Textiles — Tests for colour fastness: Part B01 Colour fastness to light: Daylight
IS/ISO 105-B02 : 2014	Textiles — Tests for colour fastness: Part B02 Colour fastness to artificial light: Xenon arc fading lamp test
IS/ISO 105-X12 : 2016	Textiles — Tests for colour fastness: Part X12 Colour fastness to rubbing (*first revision*)

ANNEX B

(*Table* 4)

METHOD FOR DETERMINATION OF MOISTURE REGAIN

B-1 PRINCIPLE

The specimen is conditioned in the standard atmosphere, weighed, oven dried, weighed again and the moisture content is calculated. From this, the moisture regain is calculated and expressed as a percentage.

B-2 APPARATUS

B-2.1 Precision Balance

B-2.2 Stainless Steel Vessels

B-2.3 Forceps

B-2.4 Hot Air Oven — Capable of maintaining at 110 ± 5°**C**.

B-2.5 Wrap Reel

B-3 CONDITIONING OF SAMPLES

The samples shall be allowed to condition at temperature of 27 ± 2°C and a relative humidity of 65 ± 2 percent before carrying out the tests. All tests shall also be performed under standard conditions (*see* IS 6359).

B-4 PROCEDURE

Weigh the yarn skein before the test (W_1) and dry in the oven at a temperature of 110 ± 5°C. After thirty minutes weigh the sample and record its mass. Subsequently carry out the weighing every twenty minutes until a constant mass (W_2) is obtained. Calculate the moisture content using the relations:

$$W = W_1 - W_2 \qquad \text{.......... (1)}$$

$$\text{Moisture content, percent} = \frac{100 \times W}{W_1}$$

B-5 CALCULATE THE MOISTURE REGAIN BY THE FOLLOWING FORMULA:

$$\text{Moisture regain, percent} = \frac{\text{Moisture content, percent} \times 100}{100 - \text{Moisture content, percent}}$$

ANNEX C

(*Table* 4)

METHOD FOR DETERMIBATION OF FINISH OIL PICK UP

C-1 PRINCIPLE

The specimen is extracted with petroleum ether in soxhlet apparatus and then distilled. The specimen is then dried, and oil pick up is calculated from the mass of original specimen and the dried specimen.

C-2 APPARATUS

C-2.1 Precision Balance

C-2.2 Stainless Steel Vessel / Conical Flask with Stopper and Plastic Beaker

C-2.3 Forceps, Tongs

C-2.4 Drying Oven

C-2.5 Plastic Tray/Bowls

C-3 PROCEDURE

C-3.1 Take the hank (normally, prepared for denier check of yarn and note down the actual weight of the sample (A).

C-3.2 Take required amount of petroleum ether in the vessel/conical flask and immerse the yarn hank in it with the help of tongs for extraction of oil from yarn samples for 15 min.

C-3.3 After 15 min take out sample from petroleum ether, squeeze it completely and then place the yarn samples in the tray, kept it in open air for 20 min for evaporation of excess petroleum ether.

C-3.4 Then put the hanks in oven at 60° C temperature. Take out the yarn sample from the oven after drying for 15 min.

C-3.5 Keep the yarns for cooling at room temperature for 10 to 15 min.

C-3.6 Weigh the yarn and note down the weight (B).

C-4 CALCULATION

Calculate the percent oil extraction by the formula:

$$\text{Percent oil extraction} = \frac{(A - \mathrm{B}) \times 100}{A}$$

NOTE — For quick and direct comparative estimation of finish oil pick up, Nuclear Magnetic Resonance (NMR) apparatus may be used.

ANNEX D

(*Table* 4)

DETERMINATION OF PHOSPHORUS CONTENT

D-1 INTRODUCTION

This method is applicable to determine phosphorus content in polymer by colorimetry. Phosphorous present in polymer sample is converted to water soluble orthophosphate form. This solution is then reacted with ammonium molybdate to form molybdophosphoric acid complex. This complex is reduced to blue colour by sodium sulfite. Intensity of this complex is measured at 710 nm using ultraviolet-visible spectrophotometer.

D-2 PURPOSE

a) Phosphorous additives are added during polymerization to control thermal degradation.

b) Phosphrous is added for flame retardant properties also.

D-3 REAGENTS

D-3.1 10 Percent Sulfuric Acid Solution (2 litres) — Add 100 ml of sulfuric acid in 2 000 ml beaker containing 500 ml demineralized water, cool the beaker to room temp and filter. Transfer the contents to 1 000 ml flasks and make up the volume with demineralized water.

D-3.2 5 Percent Ammonium Molybdate Solution (500 ml) — Weigh 25 g of ammonium molybdate and add to the 500 ml volumetric flask containing of 10 percent sulphuric acid; dissolve the salt then make upto the mark using 10 percent sulphuric acid solution (filter if necessary).

D-3.3 0.5 Percent Hydroquinone Solution (500 ml) — Weigh 2.5 g of hydroquinone and to the 500 ml volumetric flask containing 5 ml of 1N sulfuric acid; dissolve the salt then make up to the mark using demineralized water (filter if necessary).

D-3.4 20 Percent Sodium Sulphite Solution (500 ml) — Weigh 100 g of sodium sulphite and add to the 500 ml volumetric flask containing 300 ml of demineralized water; dissolve the salt then make up to the mark using demineralized water (filter if necessary).

D-3.5 Zinc Oxide Solution (200 ml) — Dissolve 20 g of zinc oxide in 200 ml of 10 percent sulphuric acid solution (filter if necessary).

D-3.6 Whatman Filter Paper No. 1

D-4 PROCEDURE

D-4.1 Preparation of Standard Solutions

Weigh 5.742 g of Di-sodium hydrogen ortho phosphate dihydrate and add to the 1 000 ml volumetric flask containing 150 ml of 10 percent sulphuric acid; dissolve the salt then make up to the mark using demineralized water. From the above flask 25 ml of solution is taken out in 250 ml volumetric flask and make up to the mark using demineralized water, this will give 100 ppm standard solution of phosphorus. From the above flask of 100 ppm solution, 10 ml of solution is taken out in 100 ml volumetric flask and make up to the mark using demineralized water, this will give 10 ppm std. solution of phosphorus. This solution is taken for calibration purpose (liquid phosphorous standard).

D-5 CALIBRATION STANDARD SOLUTION

From the liquid phosphorous standard solution made above, take 2.5, 5, 7.5, 10 and 15 ml solution in 100 ml standard volumetric flasks and add 20 ml zinc oxide solution to each flask. This will correspond to 0.25, 0.5, 0.75, 1, 1.5 ppm of phosphorous solution. Plot the graph for concentration in mg of phosphorous in 100 ml (X axis) *versus* absorption (Y axis). Calculate the slope factor (SF) from graph ($y = mx + c$).

D-6 ANALYTICAL PROCEDURE

D-6.1 Weigh 1 to 1.5 g polyester chips/yarn sample for low content phosphrous expected ~ 10 to 50 ppm. For higher contents expected 6 000 to 7 000 ppm as phosphorus, sample weight to be taken around 0.1 g in silica crucible. Keep on hot plate at 150°C for 20 min for shrinking. Remove the crucible and cool it. Add 1.5 g of zinc oxide over the polymer sample to cover it. Keep the crucible on hot plate at 250 to 280°C for 20-30 min, and then add 0.5 g of zinc oxide again in hot condition. Keep the silica crucible in furnace at 600°C for 60 min (sample will turn into white-yellowish mass) then remove the silica crucible and cool.

D-6.2 Add 20 ml of 10 percent sulphuric acid to the sample in silica crucible and dissolve the sample. Keep the sample silica crucible on the hot plate at 100°C for 10 min (till it become clear solution), cool the solution. Filter the sample solution from silica crucible if solution is not clear using Whatman filter paper no. 1. Collect the filtrate in 100 ml standard volumetric flask.

Add reagents mentioned in **D-6.3**. Dilute up to the mark with demineralized water. If expected phosphorus is 7 000 – 8 000 ppm then dilute the solution to 100 ml with demineralized water and from this solution take 10 ml solution (10 times dilution is done due to high level of phosphorus) and add 18 ml of zinc oxide solution and then add reagents mentioned in **D-6.3** to it.

D-6.3 Add following solution to each 100 ml standard volumetric flask as per the sequence given below:

a) 10 ml ammonium molybdate;

b) 5 ml sodium sulphite; and

c) 5 ml hydroquinone.

D-6.4 Make up to 100 ml with demineralized water. Take two 100 ml volumetric flasks (labeled as A and B). In A, add 5ml of liquid phosphorus standard and B use as a blank. Add 20 ml zinc oxide solution to each flask Add reagents mentioned in **D-6.3** to it. Stopper and shake all the flasks, keep the flask in dark for 60 min. Take the absorbance reading in ultraviolet spectrophotometer at 710 nm using 50 mm cuvette.

D-7 CALCULATION

D-7.1 Phosphorus content, ppm =

$$\frac{\text{Absorbance} \times 1\,000 \times \text{Dilution factor (if any)}}{\text{Sample weight (slope factor)}}$$

D-7.2 Slope factor =

$$\frac{10}{\text{Slope (of the graph of absorbance v/s concentration (mg/ml)}}$$

D-7.3 Report phosphorous content of the sample, in ppm.

ANNEX E

(*Table* 4)

DETERMINATION OF COLOUR STRENGTH AND COLOUR DIFFERENCE IN DOPE DYED YARNS

E-1 PRINCIPLE

A spectrophotometer is used to comprehend the colour difference that is not generally possible to detect by a human eye. Moreover, it gives quantitative analysis of colour difference in terms of either ΔE or colour strength. It is designed for physical sample analysis via full spectrum colour measurement.

E-2 APPARATUS

E-2.1 Card Winding Machine

This is used to prepare card samples from the yarn package. The machine can wind multiple yarns at the same time with a suitable traverse mechanism. It is possible to use one long card sample having multiple samples wound adjacent to each other. Some machines will have one sample per card.

E- 2.2 Knitting Machine

Single end knitting machine is used for knit-hose preparation. The continuous knit hose thus prepared can be used for visual inspection of colour difference as well.

E-2.3 Colour Spectrophotometer

A standard colour spectrophotometer with computerized measurement and calculation system shall be used for assessment of colour difference or colour strength. The instrument gives spectral analysis of a sample's reflectance, absorbance or transmittance properties.

E-3 SAMPLE PREPARATION

E-3.1 The sample is wound on a card made of aluminum or cardboard evenly with the layers lying parallel to each other. Care should be taken such that no surface of the base material is visible. The number of layers is dependent on the denier of the yarn being wound. Typically, about 5-8 layers are wound for getting a densely wound sample.

E-3.2 Apart from the card sample as mentioned in **E-3.1**, it is also possible to test the samples in knit hose form. Single yarn knitting machine is used for sample preparation. As knot hose produced from single end machine may not be dense, it is preferred to fold the knit hose in 4 layers while checking on a spectrophotometer.

E-4 MEASUREMENT OF COLOR STRENGTH AND COLOR DIFFERENCE

E-4.1 Calibration of the Instrument

Calibrate the instrument as per the standard operating procedure given by the supplier. Generally, it is calibrated against the perfectly white tile and a perfectly black tile. This exercise needs to be done every time the spectrophotometer is switched on and/or at intervals suggested by the supplier

E-4.2 Procedure

The assessment of colour strength and/or colour difference shall be done under **D-6.4** light source with a 10º observer mode. Place the sample (either card or folded knit hose) in the specimen section. Start the test and take 2-3 flashes per sample and note down the displayed colour strength and/or colour difference. Repeat the tests for all samples.

E-5 TEST REPORT

Report colour difference or color strength as required.

ANNEX F

(*Table* 3)

METHOD FOR DETERMINATION OF DRY HOT AIR THERMAL SHRINKAGE OF INDUSTRIAL YARNS USING AN AUTOMATIC THERMAL SHRINKAGE HOT CHAMBER / OVEN

F-1 SCOPE

F-1.1 This test method covers the measurement of shrinkage of yarns when exposed in a thermal shrinkage hot chamber or oven.

F-1.2 This test method is applicable to yarns and cords made of nylon, polyester, and other polymers not detrimentally affected by the temperature used.

F-1.3 This test method is applicable to linear densities in the range from 200 to 7 000 dtex (180 to 6 300 denier).

F-1.4 Yarns or cords for testing may be taken from yarn packages or from fabric.

F-2 SUMMARY OF TEST METHOD

F-2.1 A specimen of yarn is subjected to dry heat (as per Fig. 1) for a specified time while under a specified pre-tension. The percent shrinkage is read directly from a computer terminal display attached on the instrument while the specimen is still under tension and exposed to heat.

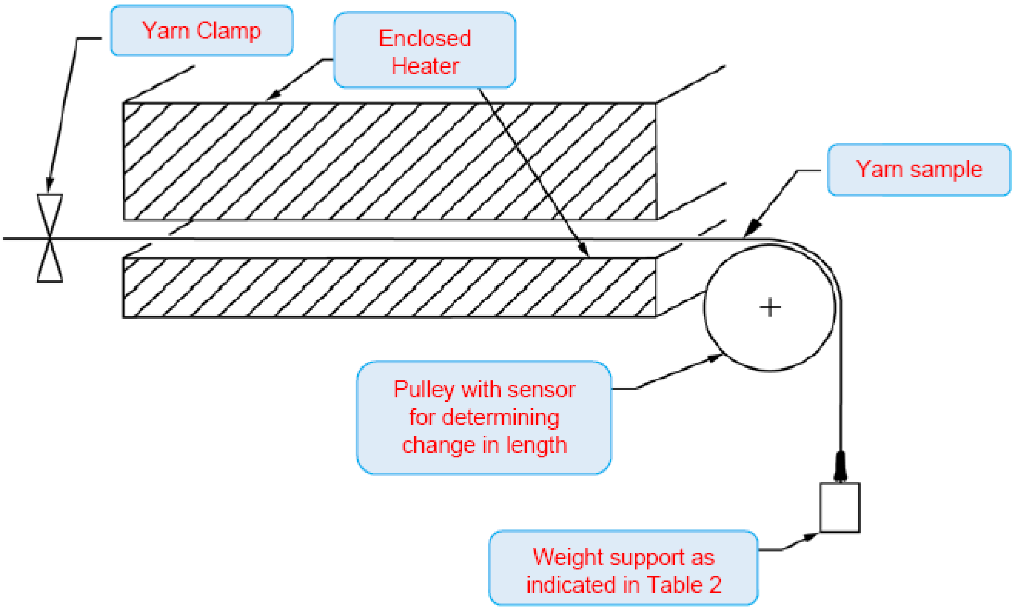
Yarn Clamp
Enclosed Heater
Yarn sample
Pulley with sensor for determining change in length
Weight support as indicated in Table 2

FIG. 1 SCHEMATIC DIAGRAM FOR DRY HOT AIR THERMAL TESTER

F-2.2 An effective draft shield is available on to the thermal chamber or oven. This is very important because the chamber in which the specimen is heated is open on three sides, air drafts can effectively alter the length of specimen experiencing the prescribed temperature environment. The attached diagram explains the test method.

F-2.3 Test Specimen

For IDY yarns, strip at least 25 m from the outside of each package in the laboratory sampling unit.

F-2.4 Inspect the outside of the package after stripping off the yarn. If there is visible damage, continue to strip off units of 25 m. and reinspect until there is no visible damage. Take one specimen and put into the clips of hot chamber. The specimen length will automatically get adjusted to 500 to 600 mm as per requirement, as this is the initial distance between the fixed clamp to the movable pulley. Discard and replace specimens that are visibly damaged.

F-2.5 Test Procedure

F-2.5.1 With the draft shield in place, set the heater chamber/oven temperature controller set point to give a specimen temperature of 180 ± 2°C. This is the temperature for yarn having normal shrinkage level.

F-2.5.2 Refer Table 8 for test conditions.

F-2.5.3 For yarn having low levels of shrinkage, a temperature setpoint of 190 ± 2°C is used.

F-2.5.4 Install one end of the specimen in the fixed clamp.

F-2.5.5 Bring the other end of the specimen over the pulley.

F-2.5.6 Attach a clip-on mass to the unclamped end of the use a mass that creates a tension load as specified in Table 9.

F-2.5.7 Refer Table 9 for the total mass needed to give such tensions for typical yarns. Start the test by pressing the start symbol on PC screen.

F-2.5.8 The draft shield will automatically come into place. The specimen is placed automatically in the centre of heater chamber channel.

F-2.5.9 At the end of 300 s (unless otherwise specified), read the percent shrinkage as indicated on the PC screen attached to instrument output, to the nearest 0.1 percent.

F-2.5.10 Remove and discard the specimen.

F-2.5.11 The test time may vary depending on specific requirement of customer and/or mutual agreement between producer and customer. A few specific applications may require test time of 900 second (15 min).

F-2.5.12 The required test temperature is generally in the range 177 to 180°C For normal shrinkage yarn.

F-3 RESULTS

The shrinkage value is directly displayed on the screen. The shrinkage is the difference between the initial specimen length and final length expressed as a percentage.

Table 8 Test Conditions

(*Clause* F-2.5.2)

Product Type	Temperature (°C)	Pre-Tension Load (g/den)	Time (s)
HT/SHT/LE/HMLS	177 - 180 ± 2°	0.05	120 – 300
LS/SLS	190 ± 2°	0.01	120 – 300

Table 9 Pre-Tension Mass for Single Strand Yarn

(*Clauses* F-2.5.6 and F-2.5.7)

Dtex	Denier	Pre-Tension Mass, Normal Shrinkage Yarn (g)	Pre-Tension Mass, Low Shrinkage Yarn (g)
940	840	42	8.5
1 100	1 000	50	10
1 440	1 300	65	13
1 650	1 500	75	15
2 200	2 000	100	20

ANNEX G

(*Foreword*)

COMMITTEE COMPOSITION

Man-Made Fibres, Cotton and their Products Sectional Committee, TXD 31

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